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Progress and prospective on the police system of renewable energy in China

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ABSTRACT

The *Renewable Energy Law* has been formulated by China government in 2005. During the next few years, there has been dramatic progress in China's renewable energy industries, along with the formation of the policy system of renewable energy in China. It is widely recognized that a reasonable and effective policy system can lay the solid foundation for the development of renewable energy. Regarding the rapid growth of renewable energy with a host of relevant policies issued in China, there is an urgent need to study the policy system of renewable energy in view of the latest situations to further promote the development of renewable energy. This paper is a systematical review about the promotion of China's policy system of renewable energy since *Renewable Energy Law* issued. Achievements on the policy system of renewable energy in 2011 as of 2005 are discussed. Experiences from recent periods are drawn and factors limiting the policy system of renewable energy are also addressed in details to probe the policy predicament and solutions. The development tendency of renewable energy is presented and the framework is drafted to set the framing constraints for China's policy system of renewable energy. Finally, policy suggestions are proposed for the successful implementation of renewable energy policies within the framing constraints of the policy system and the long-term healthy development of renewable energy in China.

Contents

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1. Introduction

Currently, issue on energy security has been paid high attention around the world. With the rapid economic growth and the increasing energy consumption, China's economic development condition deteriorates. Developing renewable energy, as an appropriate solution of energy bottleneck, is the key to healthy, rapid and sustainable development of China. China Government has attached great importance to the development of renewable energy for a long time. A host of policies have been issued to support the development of renewable energy on a large-scale. Since China Government issued *Renewable Energy Law* in 2005, developing renewable energy has become one of the key policies in China. With continuous efforts, the rapid growth of renewable energy has been witnessed, which has been extensively probed in literature [1–6]. As argued by Zhao et al. [7], China's renewable energy generation is developing from the mode of small-scale and dispersed grid-connected towards that of large-scale and centralized grid-connected. In fact, according to the international experience, the policy system of renewable energy is gradually improved with the progress of renewable energy development [8,9]. China's renewable energy development has the characteristics of late-starting, large-scale and rapid growth, so it urgently needs to research the policy system of renewable energy in view of the latest situations to promote the development of renewable energy further.

Though the government of China has already set up the targets for renewable energy development during its 10th and 11th Five-Year-Plan (FYP) periods, at the end of 2011, National Energy Administration (NEA) set up new targets during the 12th FYP, which is more difficult to achieve. The targets as followings: by 2015, the installed capacity of wind power will reach 100 million kW (including offshore wind power of 5 million kW) as well as the annual power generation will reach 190 billion kWh; the installed capacity of solar photovoltaic power will climb to 15 million kW and the annual power generation will be up to 20 billion kWh. During the 12th FYP periods, a competitive industry system of renewable energy will be established in China along with non-fossil energy of 480 million tons stand coal equivalence. As noted by Liu et al. [10], this shows the strong determination that China will pursue its long-term and sustainable way on economic and energy development. Considering the potential contribution to global efforts of fighting against GHG emissions, the abovementioned targets thereby catches intensive attention in the literatures. In an earlier study carried out by Cherni et al. [11] at 2007, the potential effectiveness of renewable energy policies in China are analyzed and the scope of *Renewable Energy Law* is investigated within the context of the electricity sector reform that China adopted. In a later study by Zhang et al. [8], policy scenarios are provided to study the opportunities and challenges of China's renewable energy policies in 2008 as of 1995 and summarize the disadvantages of the policies from the perspective of incentive and coordination. In another study by Wang [9], it analyzed three main problems about the efficiency of China renewable energy development policies from 2006 to 2008 and illustrated the necessity of developing a market-based mandatory renewable portfolio requirement in China. In a later study by Gao et al. [12], the developing strategy and relevant policies in recent years are presented and several suggestions to promote renewable energy development are provided. In addition, there are some special researches on the price policy of renewable energy in literatures [13,14]. However, all these literatures are far from enough to present the policy system of China's renewable energy.

Considering the potential impact of the policy system of renewable energy on China as well as the whole world, the issues of concerns are naturally centered on the followings: the policies made by China Government to constitute the system policy of renewable energy; relative progress and achievements on the policy system of China's renewable energy have made since *Renewable Energy Law* issued in 2005; problems and obstacles during establishing the policy system of renewable energy in China; And adjustments of great urgency in the policy system of renewable energy to deliver the target Though the focus of those literatures [8–14] is on the policies of renewable energy, the interest of this paper is to systematically review on the policy system of renewable energy. As the most populous and biggest developing country with rich renewable energy resources in the word, China's experiences are of reference value globally.

The layout of the paper is as follows. Section 2 reviews on the policy system of renewable energy in China since *Renewable Energy Law* released in 2005 and appraise the achievements supported by the policy system of renewable energy. Section 3 draws experiences from the formulation and implementation of relevant policies based on the policy system of renewable energy. Section 4 addresses the future perspective of renewable energy in China and demonstrates a framework of the policy system of renewable energy in the near future. Section 5 is the outlook for the long-term sustainable development of renewable energy in China. Finally, the conclusion is given in Section 6.

2. Progress on the policy system of renewable energy in China

2.1. Reviews on the policy system of renewable energy

Although renewable energy development has become one of the key policies in China for a very long time, the policy system of renewable energy has not been started to form until 2005, in which *Renewable Energy Law* was approved by the 4th meeting of the 10th National People's Congress. *Renewable Energy Law* is the first law related to renewable energy in China and set the keynote of renewable energy policy evolution. This law is to define the strategic significance for developing renewable energy in China and set policy measures to promote renewable energy development and determine the basic legal system as well as policy framework of China's renewable energy. Since then, a host of renewable energy policies have been put in place as follows: laws by National People's Congress (NPC); regulations and development planning by State Council and its ministries; administrative measures; price policy; finance and tax policy; technology standards; comprehensive

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Table 1
The formulation of the policy system of renewable energy in China from 2005 to 2011.

Policy type	Issued year	Policy and its concerns
Laws	2005	*Renewable Energy Law*:Require power grid enterprises sign grid accession contract with approved or registered renewable generation corporations and purchase renewable power generation at price accessed to grid [15].
	2009	*Decision on Revising Renewable Energy Law*:Revise relevant provisions as followings: Central Government should take the whole situation into account, formulate the full acquisition system and use the state funds uniformly to support the development of renewable energy [16].
Development planning	2007	*Medium and Long-Term Plan for Renewable Energy Development*:Set up the target for renewable energy development, that is non-fossil energy accounting for 10% of primary energy consumption by 2010 and 15% by 2020. Put forward the market share target for renewable energy generation (excluding hydropower) at the first time [17].
	2008	*The 11th FYP for Renewable Energy Development*:Sets general target and concrete targets for the development of renewable energy in China during the 11th FYP periods [18].
Administrative policies	2005	*Development Guidance Catalog for Renewable Energy Industry*:Show the development direction for research institutes, enterprises R&D, demonstration projects and construction investments [19].
	2006	*Related Regulations on Renewable Energy Generation*:Propose the standard development for renewable energy generation industry [20].
	2007	*Measures for Energy Saving and Power Dispatching (Trial)*:Make the generators of renewable energy without adjustment ability (such as wind energy, solar energy, hydro energy and ocean energy) rank first in the generators' ordinal table [21].
	2007	*Measures for Supervision on Power Grid Enterprise Full Purchasing Renewable Energy Power*:Promote the generation of renewable energy accessed to grid and regulate the behaviors of power grid enterprise while full purchasing renewable energy power [22].
	2009	*Implementation Plan for the Construction and Applications of Renewable Energy in Demonstration Cities*:Regulate the application standards for demonstration cities [23].
	2010	*Tentative Procedures for the Administration of Offshore Wind Power Development and Construction*:Stipulate National Energy Administration's responsibility for offshore wind power development, construction and management [24].
	2010	*Measures for Fund Management of Clean Development Mechanism in China*: Regulate the fund raising, management and use [25].
	2011	*Notice on the Integration of Construction and Applications of Solar Photoelectric*:Promote the power grid construction to facilitate solar photoelectric power access [26].
	2011	*Notice on Further Promoting the Construction and Application of Renewable Energy*:Set the target, that is the new added areas of the construction and application of renewable energy will reach over 2.5 billion m^2 and the substitute capacity of conventional energy will reach 30 million tons standard coal equivalent by the end of 2015 [27].
	2011	*Tentative Procedures for the Administration of Wind Power Development and Construction*:Regulate the development scale and speed of wind power [28].
Price policies	2006	*Tentative Procedures for the Administration of Renewable Energy Price and its Additional Expenses Allocation*:Stipulate that renewable energy should be priced by government pricing or government guidance pricing and regulate that the expenses beyond the price accessed to grid should be allocated among all power users [29].
	2006–2011	*Notice on Adjusting the Price Accessed to Grid in North China and other Regions*:Stipulate the additional price of renewable energy generating is respectively 0.1 cent/kW in 2006, 0.4 cent/kW in 2009 and 0.8 cent/kW in 2011 [30–32].
	2007	*Tentative Procedures for the Allocation of Renewable Energy Additional Price*:Propose a reasonable measure for allocating the additional price of renewable energy [33].
	2009	*Scheme on Renewable Energy Price Subsidies and Quota Trading from July to December of 2008*:Stipulate the allocation and subsidy of the additional price of renewable energy from July to December of 2008 [34].
	2009	*Notice on Perfecting the Price Policy of Wind Power Accessed to Grid*:Set different benchmarking price of wind power accessed to grid according to the four different types of resource development zones [35].
	2010	*Notice on Perfecting the Price Policy of Agriculture and Forest Biomass Generation*:Set the benchmarking price of agriculture and forest biomass generation, which is accessed to grid [36].
	2011	*Notice on Perfecting the Price Policy of Solar Photovoltaic Accessed to Grid*:Set the benchmarking price of solar photovoltaic (no-bidding) accessed to grid [37].
Financial and tax policies	2006	*Tentative Procedures for the Management of Special Funds on Renewable Energy Development*:Strengthen the management and enhance the efficiency in the use of the special funds to promote the development of renewable energy [38].
	2006	*Tentative Procedures for the Management of Special Funds on Renewable Energy Construction and Application*:Strengthen the management and improve the efficiency in the use of the special funds to promote the construction and application of renewable energy [39].
	2006	*Opinions on the Implementation of Financial and Tax Policy to Support the Development of Biomass Energy and Biological Chemical*:Regulate the financial and tax policy to support the development of biomass energy and biological chemical [40].
	2008	*Tentative Procedures for the Management of Subsidy Funds on Straw Energy-oriented Use*:Stipulate the subsidy conditions, standards and usage of the funds [41].
	2009	*Tentative Procedures for the Management of Financial Subsidy Funds on Solar Photovoltaic Construction and Application*:Stipulate the subsidy conditions, standards and usage of the funds [42].
	2009	*Tentative Procedures for the Management of Financial Subsidy Funds on Gold Sun Demonstration Project*:Stipulates the subsidy range, standards and principle of the funds [43].
	2011	*Tentative Procedures for the Management of Subsidy Funds on the Construction of Green Energy Demonstration County*:Stipulate the subsidy range, standards, principle and supervision of the funds [44].
Technology standards	2005,2011	*Technical Regulations on Wind Farm Accessing to Power Grid (2005)*:Propose technical requirements for wind farm accessing to power grid [45].*Technical Regulations on Wind Farm Accessing to Power Grid (2011)*:Revise several technical indicators, such as the active power control, the reactive power/voltage control, the active power predict, the wind farm test and propose new requirements for the ability of low-voltage ride through wind farm [46].

Note: Sourced from various resources and compiled by the authors.

measures and other special measures. All these policies have constituted the policy system of renewable energy. Table 1 summarizes the formulation of the policy system of renewable energy in China from 2005 to 2011, which has played the most significant part to promote China's renewable energy development.

2.2. Achievement supported by the policy system of renewable energy

With strong determination and vast input, China has made conspicuous progress in renewable energy development. During

the formation of the policy system of renewable energy, the solid foundation for the rapid growth of renewable energy has been laid by formulating a host of policies, drafting many development planning and huge investment. The achievement supported by the policy system of renewable energy can be witnessed as follows.

The market share of renewable energy has been expanded obviously. In recent years, China's renewable energy has achieved significant development, which was promoted by the implementation of *Renewable Energy Law* and related policies. The installed capacity of renewable energy (hydropower, nuclear power, wind power, solar power and biomass power) amounted to 27.5% of the total installed capacity of the whole country by the end of 2011, implying that China's energy supply structure have been improved with the great effort on developing renewable energy. Among them, hydropower plays a dominant role in the energy market with the installed capacity of 230 million kW, accounts for 21.8% of the total capacity. The installed capacity of nuclear power reached 12.57 million kW, accounts for 1.19% of the total capacity. The installed capacity of wind power reached 62.73 million kW with the rapid development on a large-scale (as shown in Fig. 1). With a host of policies supporting, solar photovoltaic has grown quickly in 2011 and its installed capacity reached 2.24 million kW (as shown in Fig. 2). Meanwhile, the popularization of solar thermal utilization is currently in progress and the diversified development of biomass energy and geothermal energy is also witnessed. By the end of 2011, the installed capacity of Biomass power, geothermal energy and ocean energy has respectively reached 4.36 million kW, 24,200 kW and 6000 kW.

Supported by the policy system of renewable energy, the investment risk of renewable energy has been reduced greatly and considerable investments have been put into renewable

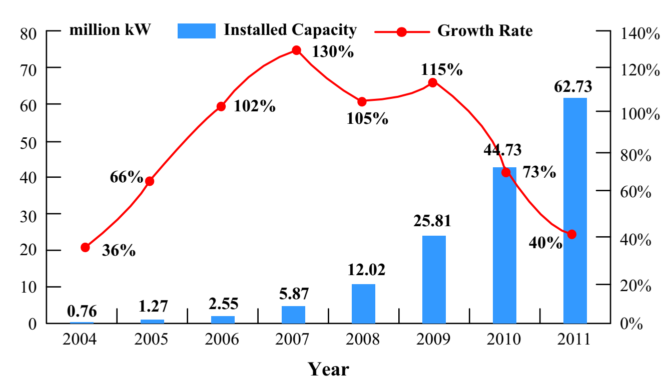


Fig. 1. Change trend of wind power installed capacity in China from 2004 to 2011. *Source:* China Wind Energy Association (CWEA) [47].

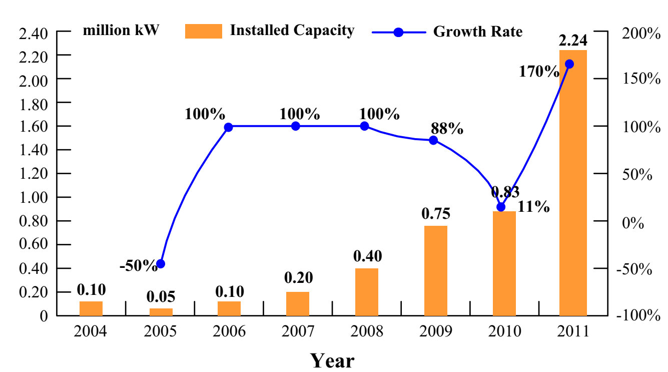


Fig. 2. Change trend of solar photovoltaic installed capacity in China from 2004 to 2011.
Source: Ref. [48].

energy industry. The large state-owned energy companies and the provincial energy investment companies have into the renewable energy market. Many large-scale groups (such as aerospace, aviation, locomotives, etc.) have begun to enter the manufacturing industry of renewable energy. The private capital of renewable energy increased from 60 billion Yuan in 2006 to 320 billion Yuan in 2010 as well. Supported by a host of policies, especially the technical specifications and standards, the manufacturing industry of renewable energy has been developing rapidly. It is worth noting that China has become the wind power equipment R&D and manufacturing base with the fastest growth rate and the installed capacity of wind power has ranked first in the world. In addition, supported by the policy system of renewable energy, international influence of China's renewable energy development has been witnessed. In China, developing renewable energy has become the main technology to reduce greenhouse gas and the renewable energy projects have accounted for 70% of the total Clean Development Mechanism ones. The great significance and positive effects to develop renewable energy in China has been highly praised by international communities.

3. Lessons and discussions on the policy system of renewable energy

The formation of policy system of renewable energy in China, though seemly successful, has some problems and obstacles deserving investigation.

3.1. Predicament in the laws

According to Chinese legislative environment, *Renewable Energy Law* just provides the basic principles for the whole country. The corresponding administrative regulations, rules and technical standards are still deficient to support the implementation of Renewable Energy Law The policies required to formulate to support the implementation of *Renewable Energy Law* are the following: formulating the special measures for developing hydropower based on *Renewable Energy Law*; providing definite technology standards for renewable resources survey; carrying out the state technology standards of renewable energy integration. In addition, it is worth noting that China Government has not established the relevant laws on managing the units accessed to grid or encouraging users to buy green power, but these laws have been existed in some developed countries and played significant roles in the development of renewable energy.

3.2. Problems in the development planning

The development planning of renewable energy set by different levels or areas are always inconsistent. Firstly, the local planning is inconsistent with the national one. For instance, in the existing national development planning of wind power, the development scheme of each year and the development scale of provinces and cities have not been defined. Driven by local interests, the local government only took the local resource situations into account without considering the capacity of renewable energy integration while making the development planning of wind power. Therefore, the development of wind power became disordered and the construction scale was far beyond that in the national planning. In *Medium and Long-Term Plan for Renewable Energy Development*, China Government has proposed target for wind power, which will climb to 30 million kW by 2020, but now the total planning capacity of wind power has reached 116.32 million kW in the areas of Jiuquan, Hami, Mengxi, Mengdong, Hebei and Jilin.

Secondly, the development planning of renewable energy is inconsistent with that of fossil power. As the generation output of wind power and solar power has the characteristics of intermittent and random, it is essential to enhance the regulation ability of renewable energy by developing corresponding capacity of conventional power. However, when local governments made the development planning of renewable energy, the electric industry structure and the capacity of renewable energy accessed to grid has not put into consideration. Regarding that the capacity of renewable energy integration mainly depends on the power structure and the peak shaving capacity of power system, the capacity of renewable energy integration will be idling if the capacity of renewable energy is far beyond the peak shaving capacity of power system. For instance, according to the existing power structure, load level and development planning, the capacity of wind power integration will be 11.3 million kW by the end of 2015 in Northeast Power Grid of China (including Mengdong area). However, the existing capacity of wind power has been more than 10 million kW in this area, which has exceeded the capacity of wind power integration.

Thirdly, the development planning of renewable energy is inconsistent with that of power grid. In China, renewable energy resources with an extremely uneven distribution, so that it does not fit the growth of electricity demand. As shown in Fig. 3, the wind energy resources are mainly distributed in Northeast China, Northwest China, northern part of North China and the eastern coastal area. As shown in Fig. 4, the solar energy resources are rich in Qinghai-Tibet Plateau, northern part of Gansu province, southern part of Xinjiang province and Ningxia province. Nonetheless, more than 75% of energy demands are concentrated in East China and Central China. In China, renewable energy is intensively exploited on a large-scale and accessed to grid by high-voltage and long-distance power grid, which needs the construction of power grid to facilitate renewable energy connection. However, the construction progress of power grid cannot catch up with the development of renewable energy. Additionally, the construction cycle of power grid projects is longer than that of renewable energy projects, which is still not considered in the development planning of renewable energy.

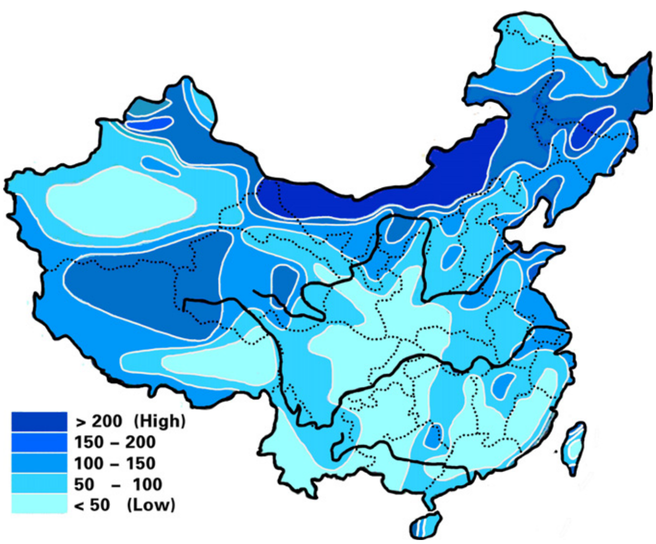


Fig. 3. The distribution of wind power resource in China (unit: W/m2). *Source:* CMA Wind and Solar Energy Resources Assessment Center [49].

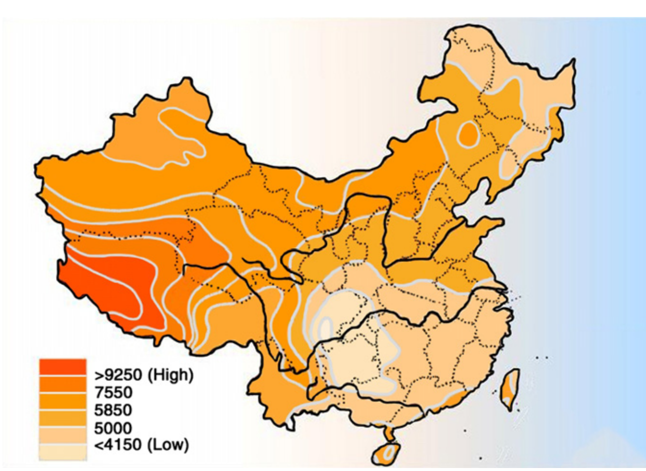


Fig. 4. The distribution of solar power resource in China (unit: MJ/ m2 year). *Source:* CMA Wind and Solar Energy Resources Assessment Center [49].

3.3. Issues on the administrative policies

At present, the evaluation data of wind power resources and solar power resources are derived from meteorological observations and that of biomass and ocean energy are obtained by the limited technology and input, thereby the resources evaluation of renewable energy lacks integrity and reliability. Meanwhile, the basic research on the resources evaluation of renewable energy is still deficient in China, such as the research of wind regime model. This model is a theoretical basis to exploit wind power resource but its data are collected from European wind power resources. Therefore, the data deviation is inevitable when the wind regime model is directly applied to the exploitation of wind power resources in China. Meanwhile, with regard to a lack of compensation standard for information sharing, the relative information of renewable energy cannot be shared by research institutions and enterprises. Thereby, the basic research of renewable energy is baffled.

Some regulations on the examination and approval of renewable energy are ambiguous. For instance, it is National Development and Reform Commission (NDRC), which supervises that all wind power projects above 50,000 kW scale, and make sure that they are implemented by the national development planning, but in fact many projects larger than 50,000 kW are usually split into small projects so that they can be approved by the local government instead of NDRC and therefore could not be implemented by the national planning [50], which results in the disorder of projects and more inconsistent development between wind power and power grid.

In addition, it is worth noting that the approval progress of power grid projects, which facilitate renewable energy integration, lags behind that of renewable energy projects and thus considerable renewable energy cannot access to grid in the condition of idling. For example, the installed capacity of Three Gorges Project in North China exceeds 10 million kW, which is far beyond the peak shaving capacity of local power system. As the distance from Three Gorges Project to the load center in North China or Northwest China is about 100 km, the capacity of wind power cannot be connected to grid without the ultra high-voltage (UHV) transmission lines and considerable idling of wind power cannot be utilized.

3.4. Dilemma in the pricing policies

On one hand, with the limited factors of renewable energy (such as technology, market scale, etc.), the price of renewable energy integration is difficult to set. The higher price will increase the burden of users but the lower one will increase the costs of

renewable energy supplier. On the other hand, the existing subsidy policy for the construction of power grid to facilitate renewable energy integration is not reasonable. Considering the lower subsidy standard is 1–3 cent/kWh, power grid enterprises have heavy pressure of loan refunding and lack initiative to promote the power grid construction. Meanwhile, the existing subsidy policy for the construction of power grid is also adverse to develop renewable energy in China. The policy only considered the construction and operation costs of in-access grid but the costs of long-distance transmission by power grid is not taken into account, which is higher than the former one. If these costs cannot be compensated for a long time, the initiative of power grid enterprises to promote the construction of long-distance transmission lines will reduce and the target for developing renewable energy on a large-scale in China may be even harder to realize.

3.5. Problems in the technology standards

Nowadays, the technology standards of wind power around the world mainly include GL standards of Lloyd (Germany), DNV standards of RISOE (Denmark) and the standards of International Electrotechnical Commission (IEC). China Government has directly taken the standards of IEC as the national ones. But the standards of IEC are set according to the national conditions of Germany and Denmark. Thus, the exiting technology standards of wind turbines do not match with the practical circumstances of China. Meanwhile, China government still lack effective technology standards to promote renewable energy integration. In 2010, although China Government issued a notice on the tentative procedures for detection and management of wind turbines integration, the standard for wind turbines participating in system frequency modulation has not been set. The technology standards of solar photovoltaic power integration are also insufficient only with three relevant standards in the national ones.

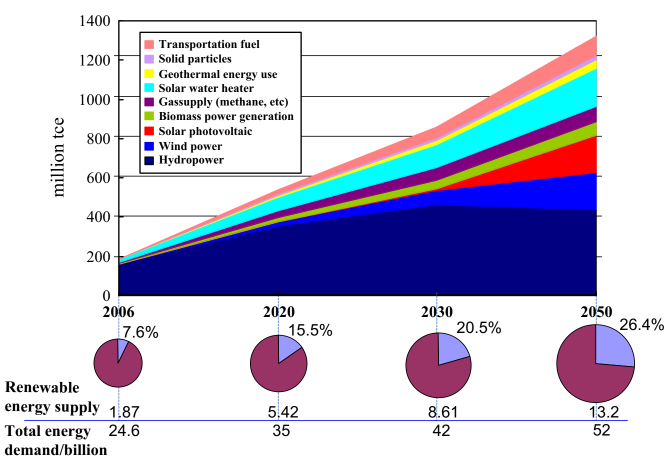


Fig. 5. The development tendency of renewable energy in China.
Source: Chinese Academy of Engineering (CAE) [53].

4. Prospective on the policy system of renewable energy in China

4.1. Development tendency of renewable energy in China

With consistent effort on formulating and implementing a host of polices to support the development of renewable energy, a miracle in the development of renewable energy has been witnessed in China. The development tendency of China's renewable energy in the near future is shown in Fig. 5. From 2010, the developing pace of wind power has begun to slow down. During the 12th FYP periods, the development mode of wind power industry should be changed from extensive style to intensive one, with the focus on the balanced development between quality and quantity [50]. Meanwhile, promoted by relevant polices, solar photovoltaic has a broad prospect in the near future with a rapid growth of solar energy industry will take place during the 12th FYP periods. The nuclear accident of Japan in 2011 will not change the direction of the nuclear power development in China and the examination and approval of nuclear power projects has already restarted. In future, safety administration will be paid high attention in the construction of nuclear power plants. Moreover, hydropower will continue to play its critical role as one of the dominating energy sources. By 2020, the installed capacity of nuclear power, wind power and solar power can respectively amount to 80 million kW, 180 million kW and 25 million kW and the share of renewable energy can account for 36.24% of the total installed capacity of the whole country, as shown in Table 2. By 2050, the installed capacity of wind power can reach 1000 million kW for meeting 17% of domestic power demand and wind power will be one of the dominating energy sources in China [51]. Meanwhile, the power grid construction will provide considerable support for the large-scale development of renewable energy. During the 12th FYP periods, State Grid Corporation of China will invest 2861 billion Yuan in the construction of smart grid, and build 5100 substations of above 220 kV and reconstruct 900 substations. The ability of resource allocation, safety guarantee and public service of the State Grid will be improved, as well as the wind power of 90 million kW and the solar power of 8 million kW can be accessed to grid by 2015 [52].

Table 2
Prediction for power source structure and installed capacity of renewable energy in China.
Source: China Electricity Council [48].

Type	2011		2015E		2020E	
	Installed capacity (GW)	Proportion (%)	Installed capacity (GW)	Proportion (%)	Installed capacity (GW)	Proportion (%)
Hydropower	230	21.43	250	18.40	380	20.40
Wind power	45.05	4.20	100	7.36	180	9.66
Nuclear power	12.57	1.17	40	2.94	80	4.29
Solar photovoltaic	2.14	0.20	5	0.37	25	1.34%
Biomass power	5.36	0.50	5	0.37	10	0.54
Geothermal power	0.024	0.0023	0.05	0.0037	0.20	0.0107
Ocean energy	0.006	0.0006	0.01	0.0007	0.02	0.0011
Total installed capacity	295.15	27.50	400.06	29.44	675.22	36.24

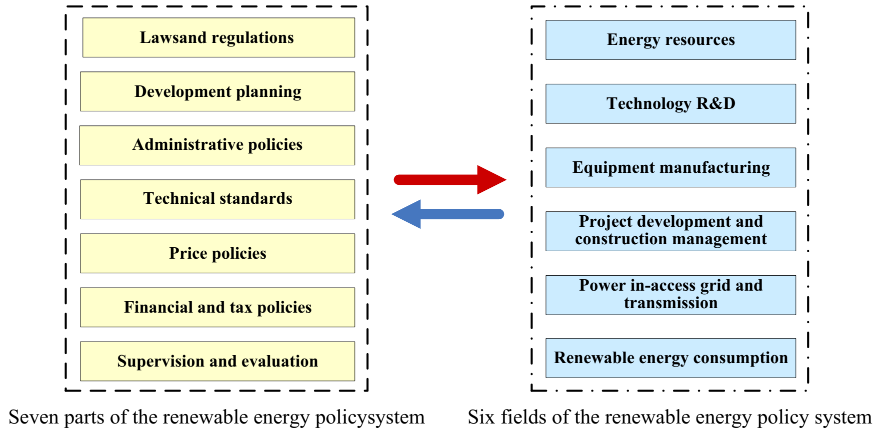


Fig. 6. Framework on the policy system of renewable energy in China. *Note*: Compiled by the authors.

4.2. Framework on the policy system of renewable energy

It is widely recognized that the policies of renewable energy are the essential basis to promote renewable energy development. According to the development tendency of renewable energy in China, the policy system of renewable energy is the solid foundation for developing renewable energy on a large-scale in the future. Although China's policy system of renewable energy has gradually formed by virtue of a host of related policies issued and implemented, the framework on the policy system of renewable energy should be established in the near future to make the implementation of renewable energy policies more effective and accurate. Learning from the former experience of the policy system of renewable energy in other countries and using it as reference, the framework on the policy system of renewable energy should be established as shown in Fig. 6. In the framework, the policy system of renewable energy is divided into seven parts according to the different contents of policies as well as six fields according to the different application range of policies.

5. Policy outlook

Regarding the existing problems and obstacles in the policy system of renewable energy and the development tendency of China's renewable energy, the policy suggestions are proposed as followings within the framework of renewable energy policy system.

5.1. Amend the laws of renewable energy

China Government should formulate *Energy Law* as the fundamental law in the energy field and determine the basic principle for the exploitation and utilization of energy to provide long-term direction for the renewable energy development. Meanwhile, the Central Government should make clear the responsibility of every department, especially the obligation about setting and evaluating the medium and long-term targets of renewable energy development. Furthermore, in *Renewable Energy Law*, the implementation principles and evaluation measures for the system of fully acquiring renewable energy should be defined. Additionally, though *Renewable Energy Law* stipulates that the generation enterprise has obligation to cooperate with power grid enterprises to ensure the safety of power grid when integration, the relationship between ensuring power grid safety and acquiring renewable energy fully should been made clear and its conduct code should be also formulated to deal with the contradictions between them. Furthermore, the regulation on encouraging users to purchase more renewable energy should be supplemented into *Renewable Energy Law* when the development of renewable energy reach a certain scale in China.

5.2. Make clear the development planning of renewable energy

The decomposition procedure, which decomposes the national targets of renewable energy development into the concrete ones for each province in each year, should be set to keep consistent between the national development planning and the regional ones. With regard to the coordination between the development of renewable energy and that of power grid, the government should consider the development planning of renewable energy when formulating the medium and long-term planning of power grid, meanwhile, a scheme on the construction order of renewable energy projects should be made according to the capacity of integration of renewable energy. Meanwhile, due to the intermittency and randomness of wind power and solar power, a certain amount of conventional power should be planned for peak shaving in order to ensure the rationality of power structure. Additionally, the Central Government should strengthen the macro-control of the construction of renewable energy projects and approve the renewable energy projects in accordance with the national development planning of renewable energy.

5.3. Improve the administrative policies of renewable energy

During the 12th FYP periods, China Government should formulate and implement Renewable Portfolio Standard (RPS) as soon as possible to further promote the large-scale development of renewable energy. Meanwhile, the 12th PYF focuses on coordinating the relationship between development, construction and management of renewable energy project. The Central Government should define the approval responsibility among different departments and make clear the approval process of renewable energy projects. The administrative measure should be made to promote the synchronous construction of renewable energy projects and power grid projects which facilitate renewable energy integration. The government should make the implementing regulation for transmitting renewable energy and put a certain amount of hydropower or thermal power into consideration in order to improve the economy of transmission system and the stability of power grid. Moreover, regarding the problem of peak-load regulation while developing the renewable energy on a large-scale, the relevant regulation should be formulated to promote the coordinated development between renewable

energy and peak-load regulation power source (such as pumped storage). Additionally, the policy on the resource survey of renewable energy should be published and the priority of resource survey should be given to wind power and solar power in the near future. The resource survey of geothermal and ocean energy should also be put on the agenda. Through the resource survey, the technology roadmap of renewable energy resources in China will be drafted to provide more data for the development of renewable energy.

5.4. Perfect the price policies of renewable energy

China Government should perfect the price policies of renewable energy integration. Considering the characteristics of generation technology, costs, market and regional resources conditions, the reasonable benchmarking price of renewable energy integration should be set in order so that the same kind of renewable energy power generation projects can basically obtain the same price integration in the same region. Moreover, different pricing measures should be taken into consideration according to the costs and loan refunding of different power grid construction which facilitate renewable energy integration. For the small-scale renewable energy projects, the price integration can be adopted in terms of the regional benchmarking price. But for the large-scale renewable energy projects, the price integration should be set according to the costs of large-scale construction and long-distance transmission of power grid and the loan refunding of the projects. In fact, the expense, which derives from the costs for the construction and transmission of power grid to facilitate renewable energy integration, usually exceeds that of conventional energy. Under this situation, that part can be allocated nationwide to relieve the cost pressure of the power grid enterprises.

5.5. Formulate and revise the technology standards of renewable energy

Regarding the latest regulation on the technology standards of wind power released by Standardization Administration of China (SAC) in December of 2011 [46], the national technology standards of solar photovoltaic power should be set as soon as possible. Meanwhile, the government should issue the policy to promote the construction of national testing centers and further encourage the examination of the technology of renewable energy integration. The mandatory authentication system for renewable energy accessed to grid should be established as well to ensure the reliability of power grid operation. Furthermore, learning from the advanced experience of developed countries, the technology standards are of great urgency to guide the operation of renewable energy stations. Meanwhile, it is essential to set up a forecasting system of renewable energy generation so as to improve the reliability of power grid operation, which can promote the renewable energy integration.

5.6. Establish a supervision and evaluation system for renewable energy policies

To ensure the effective implementation of renewable energy policies, the government should establish relative the supervision and evaluation system as soon as possible. In the near future, this system should focus on the policies about renewable energy price, renewable energy integration and the allocation of the extra expenses of power grid enterprises. Through the supervision and evaluation, the government will be able to investigate and treat the illegal behaviors as well as safeguard the legitimate interests of market subject. Meanwhile, the government should strengthen the information disclosure of renewable energy integration, including price, the capacity integration, the extra allocated income, etc. All these work aims to ensure the public's rights to know and realize the important information sharing for the long-tem sustainable development of renewable energy.

6. Conclusion

Renewable Energy Law was issued in 2005 and sustainable development has been officially taken as one of the cores of Scientific Development Perspective in the 17th conference of CPC. After that, a host of renewable energy policies have been published, including relative laws, regulations, development planning, administrative policies, price policies, finance and tax policies as well as technology standards, etc. During these periods, the policy system of renewable energy has begun to form. On the one hand, the formation of the policy system of renewable energy has laid the sound foundation for China's renewable energy development. Meanwhile, the formulation and implementation of vast policies has promoted remarkable development of renewable energy. On the other hand, it's still the initial phase of renewable energy development in China and the government's policy system of renewable energy still needs to be further improved. With the rapid growth of renewable energy, the emerging problems and obstacles in some policies are of great urgency to investigate, furthermore, the solution of the policy bottlenecks needs to be taken into consideration. Regarding the development tendency of China's renewable energy, it is an evitable choice for China Government to implement more policies to support the healthy and sustainable development of renewable energy in the future. Continuously perfecting the policy system of renewable energy will make significant contribution to the establishment of a sustainable energy system, so that the long-term healthy development of economy and society will be able to achieve.

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